

Iceberg noise distributions

DUNE Cold Electronics

David Adams

BNL

July 12, 2021

Introduction

Shekhar asked for Iceberg noise distributions

- For update of the TDR
- I produced plots comparing runs 3, 4 and 5
 - PDSP, COTS and 3-ASIC FEMBS
 - ENC, sample noise and integrated noise
 - Latter is 40-tick; easy to add others

Definitions

Sample and integrated noise is for area-calibrated signals

- ADC spectrum is calibrated so the the area under a (collection plane) pulse gives the collected charge
 - Units for a sample are charge/tick, e.g. ke/tick
- Sample noise is the RMS for single sample
 - Measured by excluding signal regions
- N-tick integrated noise is the RMS of a sum of N contiguous samples
 - Need something like $N = 30-50$ sample for signals from tracks far from perpendicular to the APA
 - Here use $N = 40$

ENC is sample noise but with height calibration

- If the signal is very fast, i.e. collection and formation times are small compared to shaping time, the signal height can be used to measure the charge
- This is not the case for detector signals but ENC is common metric

Procedure

Sample and integrated noises evaluated by

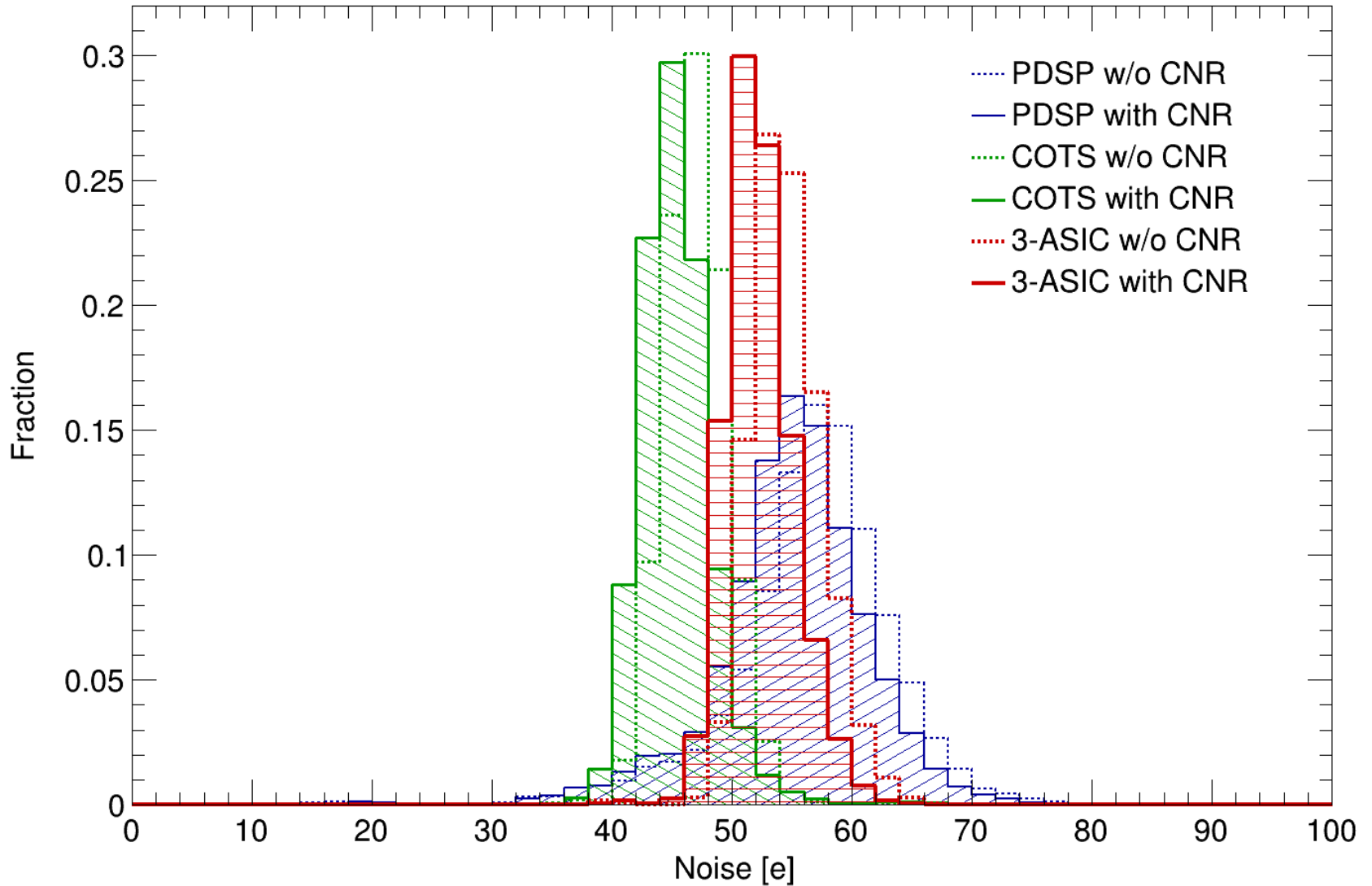
- Looking only at channels identified as “good”
- Select regions with no signals
- Evaluating RMS

ENC obtained by scaling sample noise by A/h

- I.e. area/height for fast signal
- For 2 us shaping in runs 3, 4 (2 MHz sampling), $A/h = 5.584$
- For 2 us in run 5 (1.953 MHz sampling), $A/h = 5.453$

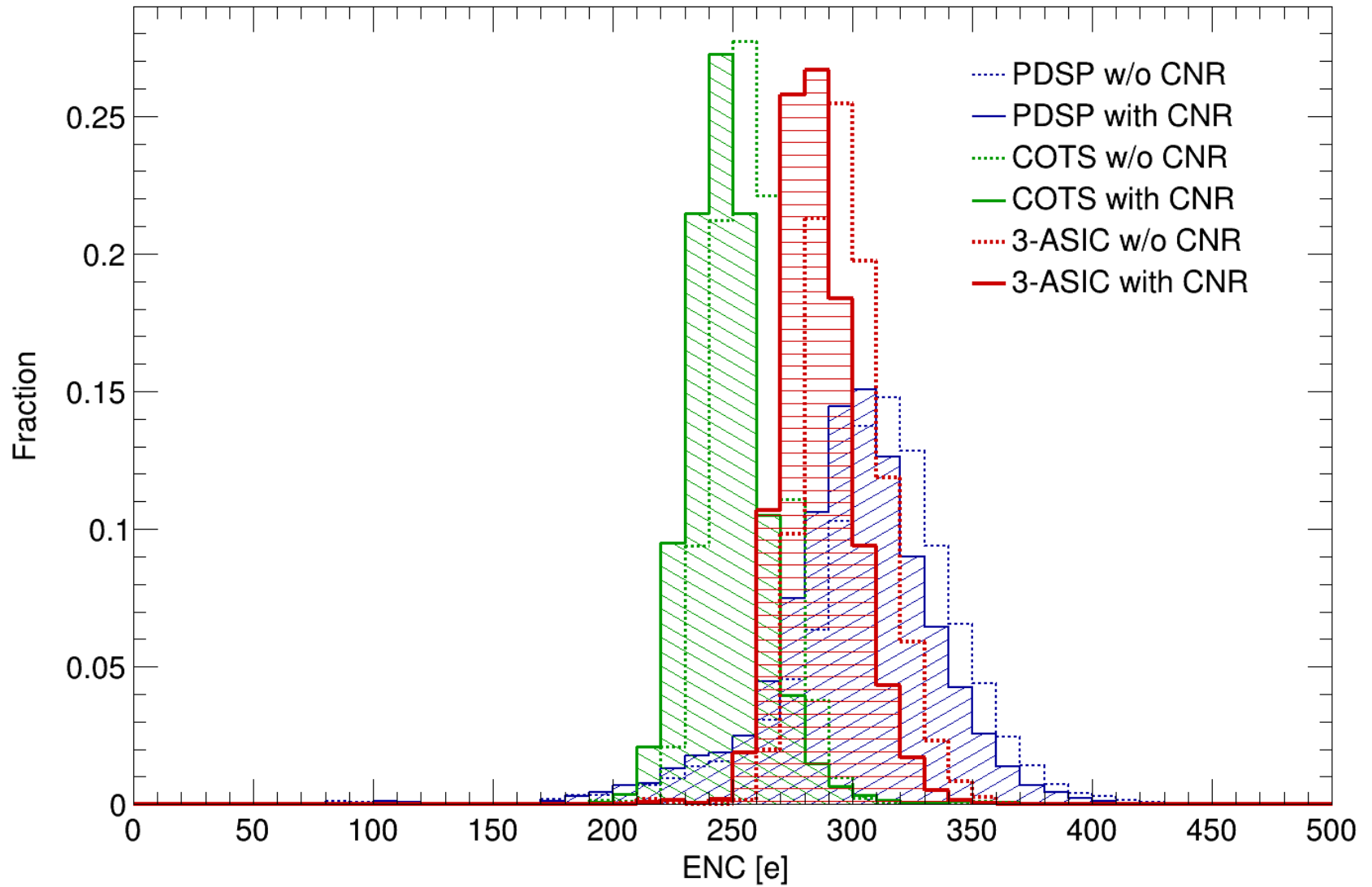
Sample noise

Sample noise



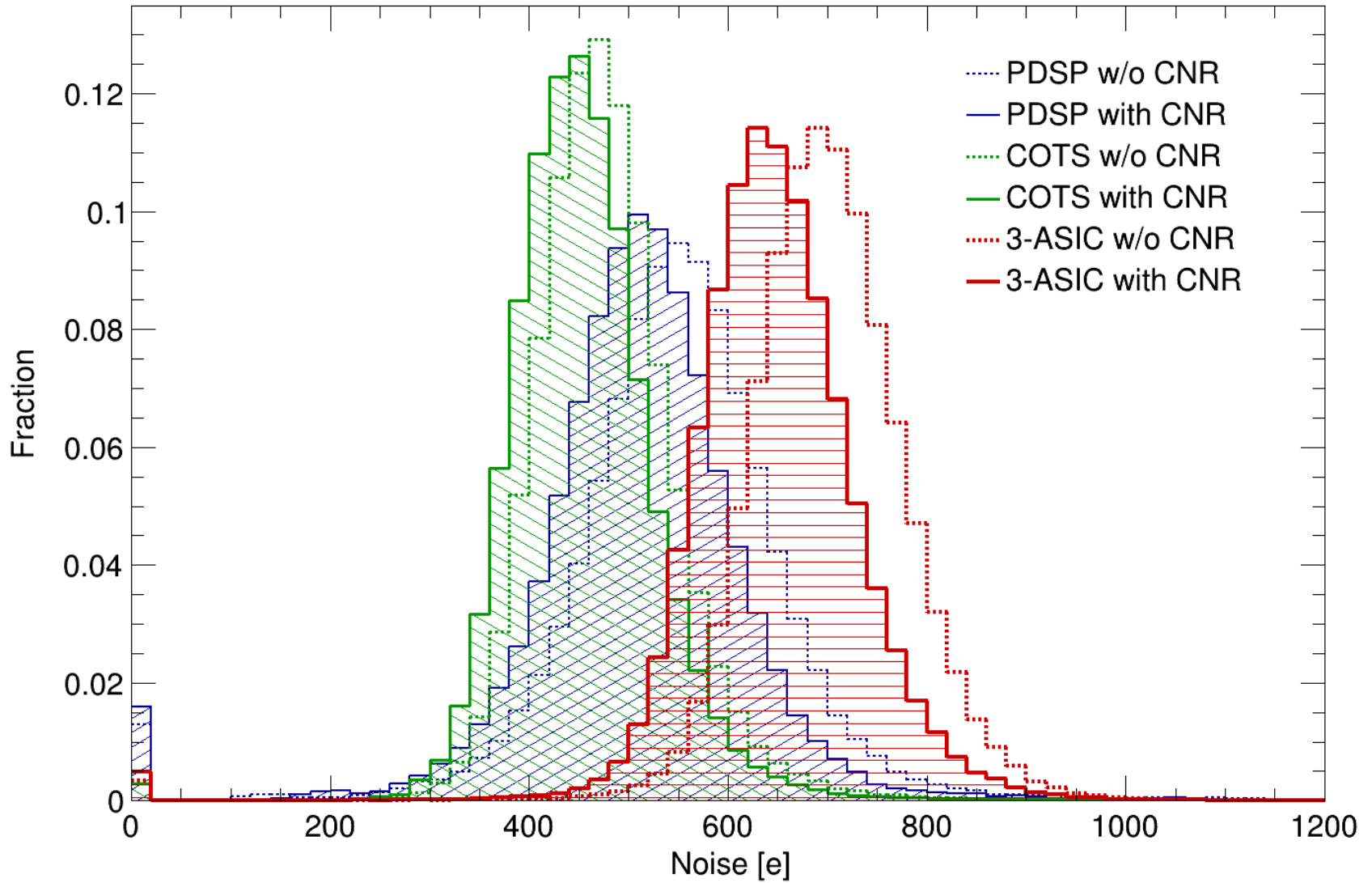
ENC

ENC



Integrated noise

40-tick integrated noise



Comments

Sample noise and ENC look similar

- Although at different scales
- COTS has less noise than ProtoDUNE
- 3-ASIC is between these

Integrated noise is different

- Again COTS has less noise than ProtoDUNE
- But 3-ASIC noise is well above either
 - There is much more sample-to-sample (time) correlation
- Important for physics if this is also seen in the longer DUNE wires and in the new FEMBs